APPENDIX A: DESIGN CRITERIA

Hatch Mott MacDonald

Davenport Diamond Feasibility Study Update 2015

Design Criteria

Issue and Revision Record					
Rev	**Date**	**Originator**	**Checker**	**Approver**	**Description**
0	2015-09-30	M. Armstrong	J. Pehar	J. Moreash	Final

Hatch Mott MacDonald

Project Report

30 September 2015

GO Transit
Davenport Diamond Feasibility Study

Design Criteria

Table of Contents

1. Background

GO Transit proposes to construct a rail-to-rail grade separation at Davenport Diamond, along the GO Newmarket Subdivision (S/D) in the city of Toronto (north-west of the downtown core).

This project is intended to eliminate the level crossing that currently exists between the GO Newmarket S/D and the CP North Toronto S/D at the Davenport Diamond. Presently, the GO Service on the Barrie Corridor is limited to 14 trains a day (seven return trips) which is hindering the ability to maintain service reliability and potentially increase service levels on this corridor.

Hatch Mott MacDonald (HMM) understands that GO Transit has taken sole ownership of the CN Newmarket S/D since the Feasibility Study was initiated in 2010. Some references to CN requirements in the Design Criteria have been maintained as they are still applicable to previously studied Alternatives; however, only GO Transit requirements apply to the newly proposed Alternative 4.

For the purpose of this report, and for design and construction, the structure is considered to be oriented in the north-west direction.

The Davenport Diamond is located in Toronto (approximately 7.5 km from Union Station) north of Dupont Street, south of Davenport Road and west of Dufferin Street.

1.1 Existing Railway Infrastructure

1.1.1 GO Newmarket S/D

A single track services GO Transit on the majority of the Barrie Rail Corridor. The GO Newmarket S/D crosses the CP North Toronto S/D at Mile 4.6. The GO Newmarket S/D is designated as an emergency relief track for CN freight service arriving and departing from the MacMillan Yard located west of the CN Newmarket S/D on the nearby CN York S/D. This emergency relief allows CN freight traffic to circumvent track blockages on the CN Halton (west of MacMillan Yard), the CN York S/D or the GO Weston Sub. Local freight service no longer extends as far south as the Davenport Diamond. Local freight service currently operates as far south as Mile 9.2 on the CN Newmarket S/D and serviced from the CN York S/D.

1.1.2 CP North Toronto S/D

Canadian Pacific's main route from Montreal, through Toronto, carrying freight traffic on the North Toronto S/D consists of an average of 50-60 freight trains per day. The S/D consists of two tracks through the diamond (Mile 5.26).

1.2 Existing Road Infrastructure

Within the study area there multiple road crossings with major arterial, minor arterial and collector roads, which are defined as follows (City of Toronto, 2007):

- Major Arterial:
  - Traffic movement is a primary function.
  - Subject to access controls.
  - Greater than 20,000 vehicles per day.

- Greater than 5,000 bus (or streetcar) passengers per day.
- Speed limits 50 to 60 km/hr.
- Sidewalks on both sides; may have bicycle lanes.
- High priority of winter maintenance.

- Minor Arterial:
  - Traffic movement is a primary function.
  - 8,000 to 20,000 vehicles per day.
  - 1,500 to 5,000 bus (or streetcar) passengers per day.
  - Speed limits 40 to 60 km/hr.
  - No “Stop” signs; main intersections controlled by traffic signals.
  - Sidewalks on both sides; may have bicycle lanes.
  - High priority of winter maintenance.

- Collector:
  - Provide access to property and traffic movement.
  - 2,500 to 8,000 vehicles per day.
  - Less than 1,500 bus (or streetcar) passengers per day.
  - Signalized intersections at arterial roads.
  - Sidewalks on both sides of the road.
  - Medium priority for winter maintenance.

1.2.1 St. Clair Avenue West

East-west major arterial roadway which crosses the GO Newmarket S/D with a road under rail grade separation. St Clair Avenue West has four through lanes with streetcar tracks in both directions, and intermittent parking lanes. Intersections within the study area include Keele Street, Old Weston Road, Hounslow Heath Road, Laughton Avenue, Caledonia Road, Lansdowne Avenue, Earlscourt Avenue, Via Italia, and Dufferin Street.

1.2.2 Davenport Road

East-west minor arterial roadway which crosses the GO Newmarket S/D with a road under rail grade separation. Davenport road has two through lanes, two parking lanes, and bike lanes. Intersections within the study area include signalized Lansdowne Avenue, Old Weston Road, Laughton Avenue, Symington Avenue, Caledonia Park Road, and Dufferin Street.

1.2.3 Dupont Street

East-west major arterial roadway which crosses the GO Newmarket S/D with a road under rail grade separation. Dupont Street has four through lanes and two bike lanes. Signalized

intersections within the study area include Dundas Street, Edwin Avenue, Symington Avenue, Lansdowne Avenue, and Dufferin Street.

1.2.4 Wallace Avenue

East-west collector roadway with an at-grade crossing of the GO Newmarket S/D. Wallace Avenue has two through lanes and one parking lane. Intersections within the study area include Symington Avenue, Lansdowne Avenue, and Dufferin Street.

1.2.5 Bloor Street

East-west major arterial roadway which crosses the GO Newmarket S/D with a road under rail grade separation. Bloor Street has four through lanes. Signalized intersections within the study area include Keele Street, Dundas Street West, Lansdowne Avenue, and Dufferin Street.

1.2.6 Keele Street

North-south major arterial roadway which crosses the CP Galt S/D (Mile 4.94) with a road under rail grade separation. Keele Street has four through lanes and signalized intersections at Bloor Street, Glenlake Avenue, Humberside Drive, Annette Street, Dundas Street, West Toronto Street, and St. Clair Avenue West.

1.2.7 Osler Street

North-south collector roadway which crosses the CP North Toronto S/D (Mile 5.70) at-grade. Osler Street has two through lanes and unsignalized intersections at Davenport Road and Dupont Street.

1.2.8 Symington Avenue

North-south minor arterial roadway which crosses the CP North Toronto S/D with a road under rail grade separation. Symington Avenue has four through lanes and signalized intersections at Bloor Street, Dupont Street, and Davenport Road.

1.2.9 Lansdowne Avenue

North-south minor arterial roadway which crosses the CP North Toronto S/D with a road under rail grade separation. Lansdowne Avenue has four through lanes and signalized intersections at Bloor Street, Dupont Street, Davenport Road, and St. Clair Avenue West.

1.2.10 Dufferin Street

North-south major arterial roadway which crosses the CP North Toronto S/D with a road under rail grade separation. Dufferin Street has four through lanes and signalized intersections at Bloor Street, Dupont Street, Davenport Road, and St. Clair Avenue West.

1.3 Design Standards

The reference Design Standards and additional design requirements for this project are summarized as follows. The latest version of each Standard shall be used. If multiple users are intended to utilize the same tracks the requirements of the track owner will take precedence.

Rail Structure Requirements:

- Design of any proposed rail bridge, guideway or retaining wall shall be carried out in accordance with all applicable sections of the American Railway Engineering and Maintenance-of-Way (AREMA) Manual of Practice, unless otherwise superseded by requirements of the railway owner.
- All structural steel should be specified to conform to CSA standard CAN/CSA-G40.21-M92 and be grade 350AT Category.
- All cast in place concrete components shall be designed using 35 MPa concrete.
- Consideration for the provision of acoustic mitigation shall be made.
- Fire life safety design shall be in accordance with National Fire Protection Association (NFPA) Standard for Fixed Guideway Transit and Passenger Rail Systems. This includes, but is not limited to, the following provisions:
  - Means of egress shall be a minimum 760 mm wide, non-combustible walking surface.

1.3.1 Railways

1.3.1.1 AREMA

- Manual for Railway Engineering - Volume 1 (2012).
- Practical Guide to Railway Engineering (2003).

1.3.1.2 CN Requirements (for reference to earlier options only)

- CN Standard Practice Circular (SPC 2004).
- CN Track Standard Drawings (TS 2002).
- CN Recommended Methods (RM 2004).
- CN structures, if applicable, should be designed for the full potential loading with Cooper E90 live loading plus impact, and an imposed dead load of 700 mm of ballast.
- Impact, where applicable for the structure, should be based on the impact given in the AREMA manual.

1.3.1.3 CP Requirements

- CP Standard Practice Circular (SPC 2000).
- Canadian Pacific Railway (CP), Requirements for the design of steel and concrete bridges carrying railway traffic in Canada, October 16, 2006.
- Crash walls: Protection of Structure Adjacent to Railroad Tracks.
- Operating speeds: North Toronto S/D speeds should be maximized (50 to 60 mph).
- Temporary operating requirements and restrictions during construction: Expected that daily operations are not impacted. Refer to “Operational Constraint for Work On, Above, or Below Railway Right of Way”, CPR.

1.3.1.4 GO Transit Requirements

- GO Transit Design Requirements Manual, June 2014 Version 14.0 (DRM).
- Design live load: Cooper E80 plus impact.
- Direct fixation track to be utilized on guideway structures; no allowance for future ballast to be provided.
- Direct fixation fastener used shall ensure impact forces on structure are less than or equal to AREMA values for a ballasted track structure.
- 'Passive protection' for future electrification shall be provided.

1.3.1.5 Roads and Bridges

- Transportation Association of Canada (TAC) Urban Supplement to the Geometric Design Guide for Canadian Roads. 1999 (*note June 2014 Errata*)
- Canadian Highway Bridge Design Code (CHBDC) CAN-CSA S6-00. 2010
- Transportation Association of Canada (TAC) - Turning Vehicle Templates. 1993
- Ontario Building Code (OBC): as applicable to fire hydrants and fire routes. 2012
- Local Municipality: issues pertaining to site access, curb cuts, traffic signals, pedestrian crossings, bike lanes, etc.
- Ontario Provincial Standards: curbs, fencing, manholes, catch basins, concrete barrier, curbs, bumper curbs and bollards. 2014
- MTO: line marking specifications. 2011
- List of City of Toronto, Standard Construction Specifications, April 2014
- List of City of Toronto, Standard Construction Drawings for Roads, April 2014

2. Design Criteria

The design criteria are summarized below:

Table 1: Number of Tracks

GO Newmarket S/D	GO Transit	Two tracks to accommodate future Barrie Corridor all day service with the provision for a potential future third express track in future.
	CN	No dedicated freight route.
CP North Toronto S/D		Four tracks and an access road, to accommodate two existing tracks and future two tracks for Eglinton Crosstown Corridor

Table 2: Design Speed

Subdivision	Freight/Passenger	Design Speed (mph)	Construction Design Speed (mph)	Reference
Newmarket	Passenger Freight	45 35	20 20	CN LETTER dated February 12, 2009 from Daryl Barnett
North Toronto	Freight	50-60	Minimum 50	CP LETTER dated February 20, 2009 from Steve Rowe

Table 3: Horizontal Curves and Spirals

Item	Reference
Maximum horizontal curvature	CP SPC02 CN SPC1305
Spiral lengths	CP SPC02 CN SPC1305
Minimum length of tangent between reverse curves	CP SPC02 CN SPC1305
Superelevation	CP SPC02 CN SPC1305

Table 4: Grades and Vertical Curves

Item	Specification	Reference
Maximum compensated grade GO Transit	Not to exceed compensated ruling grade (2.00%)	As per Metrolinx RTQ May 5, 2014
Ruling Grade GO Newmarket S/D	2.00%	As per Metrolinx RTQ May 5, 2014
Ruling Grade CP North Toronto S/D	0.32%	CP LETTER dated February 20, 2009 from Steve Rowe
Compensation rate for degree of curvature	0.04% per degree	AREMA Chapter 5 Part 3 Section 3.7
Vertical Curve	As per Section 3.6	AREMA Chapter 5 Part 3

Table 5: Track Clearances

Item	Specification	Reference
Minimum track centres	4.27 m (14 ft.)	CP SPC 03 CN SPC 2103 GO DRM CI-0804
Minimum side clearance from track centreline	As per 2008SD-01 As per TS-3003 As per CI-0807	CP 2008SD-01 CN TS-3003 GO DRM CI-0807
Minimum vertical clearance above top of GO Transit rail for future electrification[1]	7.4 m (24 ft.)	GO DRM CI-0807
Minimum vertical clearance above top of rail (CN)[1] Minimum vertical clearance above top of rail (CP)[1,2]	6.7 m (22 ft.) 7.01 m (23 ft.)	CN SPC 2103 GO DRM CI-0807 CP SPC 03

Table 6: Temporary Works

Item	Specification	Reference
Minimum Vertical Clearance above top of rail	7.01 m (23 ft.) 6.71 m (22 ft.)	GO DRM CI-0807 CN TS-3003 CP 2008SD-01
Minimum Horizontal Clearance from track centreline	3.66 m (12 ft.) without prior written consent TS-3003 must be adhered to during construction	CP "Operational Constraint for Work On, Above, or Below Railway Right of Way". CN LETTER dated February 12, 2009 from Daryl Barnett

Table 7: Road Design Criteria

Road Classification	Collector	Minor Arterial		Major Arterial		Reference
Design speed (km/h)	50	50	60	50	60	
Min grade (%)	0.5	0.5	0.5	0.5	0.5	TAC Manual 1999+
Max grade (%)	6	6	6	6	6	TAC Manual 1999+
Max superelevation rate (m/m)	0.06	0.06	0.06	0.06	0.06	TAC Manual 1999+
Min radius (m)	75	75	120	75	120	TAC Manual 1999+
Min radius for normal crown (m)	950	950	1290	950	1290	TAC Manual 1999+
Minimum Stopping Sight Distance (m)	110	110	130	110	130	TAC Manual 1999+
Decision Sight Distance (m)	200	200	235	200	235	TAC Manual 1999+
Vertical Curves (min K) Crest Sag Sag (illuminated)	 7 12 6	 7 12 6	 13 18 9	 7 12 6	 13 18 9	TAC Manual 1999+
Traffic lane width (m)	3.5	3.5	3.5-3.7	3.7	3.7	TAC Manual 1999+
Shoulder width (m)	-	-	-	-	-	

Road Classification	Collector	Minor Arterial		Major Arterial		Reference
Concrete sidewalk width (m)	1.7	1.7	1.7	1.7	1.7	TS-310.010-2 TS-310.010-3 TS-310.010-4
Bike lane width (m)	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	TAC Manual 1999+
Minimum vertical clearance (m)	5	5	5	5	5	TAC Manual 1999+

M. Armstrong
MA:lds